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MARSHALL, GERSTEIN &amp; BORUN

No. 6632 P. 2/3

FORM PTO 1590 (Modified)  
REV 11-2000

U.S. DEPARTMENT OF COMMERCE PATENT AND TRADEMARK OFFICE

ATTORNEY'S NAME AND FIRM

**TRANSMITTAL LETTER TO THE UNITED STATES  
DESIGNATED/ELECTED OFFICE (DO/EO/US)  
CONCERNING A FILING UNDER 35 U.S.C. 371**

30051/37969

U.S. APPLICATION NO (IF KNOWN SEE 37 CFR

INTERNATIONAL APPLICATION NO.  
PCT/EPC0/05362INTERNATIONAL FILING DATE  
June 9, 2000PRIORITY DATE CLAIMED  
June 9, 1999

## TITLE OF INVENTION

CONTROLLER AND METHOD FOR CONTROLLING THE  
FLOW OF BREWER'S WORT FROM A CLARIFYING VAT

## APPLICANT(S) FOR DO/EO/US

Ulrich Hege

Applicant herewith submits to the United States Designated/Elected Office (DO/EO/US) the following items and other information.

1. ☒ This is a **FIRST** submission of items concerning a filing under 35 U.S.C. 371.
2. ☐ This is a **SECOND** or **SUBSEQUENT** submission of items concerning a filing under 35 U.S.C. 371.
3. ☒ This is an express request to begin national examination procedures (35 U.S.C. 371(f)). The submission must include items (5), (6), (9) and (24) indicated below.
4. ☐ The US has been elected by the expiration of 19 months from the priority date (Article 31).
5. ☒ A copy of the International Application as filed (35 U.S.C. 371 (c) (2))
  - a. ☐ is attached hereto (required only if not communicated by the International Bureau).
  - b. ☒ has been communicated by the International Bureau.
  - c. ☐ is not required, as the application was filed in the United States Receiving Office (RO/US).
6. ☒ An English language translation of the International Application as filed (35 U.S.C. 371(c)(2)).
  - a. ☒ is attached hereto.
  - b. ☐ has been previously submitted under 35 U.S.C. 154(d)(4).
7. ☐ Amendments to the claims of the International Application under PCT Article 19 (35 U.S.C. 371 (c)(3))
  - a. ☐ are attached hereto (required only if not communicated by the International Bureau).
  - b. ☐ have been communicated by the International Bureau.
  - c. ☐ have not been made; however, the time limit for making such amendments has NOT expired.
  - d. ☐ have not been made and will not be made.
8. ☐ An English language translation of the amendments to the claims under PCT Article 19 (35 U.S.C. 371(c)(3)).
9. ☒ An oath or declaration of the inventor(s) (35 U.S.C. 371 (c)(4)). In Blank
10. ☐ An English language translation of the annexes of the International Preliminary Examination Report under PCT Article 36 (35 U.S.C. 371 (c)(5))
11. ☒ A copy of the International Preliminary Examination Report (PCT/IPEA/409).
12. ☒ A copy of the International Search Report (PCT/ISA/210).

## Items 13 to 20 below concern document(s) or information included:

13. ☐ An Information Disclosure Statement under 37 CFR 1.97 and 1.98.
14. ☐ An assignment document for recording. A separate cover sheet in compliance with 37 CFR 3.28 and 3.31 is included
15. ☒ A **FIRST** preliminary amendment.
16. ☐ A **SECOND** or **SUBSEQUENT** preliminary amendment.
17. ☐ A substitute specification.
18. ☐ A change of power of attorney and/or address letter.
19. ☐ A computer-readable form of the sequence listing in accordance with PCT Rule 13ter.2 and 35 U.S.C. 1.821 - 1.825.
20. ☐ A second copy of the published international application under 35 U.S.C. 154(d)(4).
21. ☐ A second copy of the English language translation of the international application under 35 U.S.C. 154(d)(4)
22. ☒ Certificate of Mailing by Express Mail
23. ☒ Other items or information: WIPO Publication Number WO 00/77263 A3 (cover sheet);  
PCT Form 210; PCT Form 101; Pct Form 401; PCT Form 409;  
General Authorization

U.S. APPLICATION NO. (IF KNOWN, SEE 37 CFR		INTERNATIONAL APPLICATION NO. PCT/EP00/ 05362		ATTORNEY'S DOCKET NUMBER 30051/37969	
24. The following fees are submitted:				CALCULATIONS (HOUSE ONLY)	
BASIC NATIONAL FEE (37 CFR 1.492 (a) (1) - (5)):					
<input type="checkbox"/> Neither international preliminary examination fee (37 CFR 1.482) nor international search fee (37 CFR 1.445(a)(2)) paid to USPTO and International Search Report not prepared by the EPO or JPO				\$1040.00	
<input checked="" type="checkbox"/> International preliminary examination fee (37 CFR 1.482) not paid to USPTO but International Search Report prepared by the EPO or JPO				\$890.00	
<input type="checkbox"/> International preliminary examination fee (37 CFR 1.482) not paid to USPTO but international search fee (37 CFR 1.445(a)(2)) paid to USPTO				\$740.00	
<input type="checkbox"/> International preliminary examination fee (37 CFR 1.482) paid to USPTO but all claims did not satisfy provisions of PCT Article 33(1)-(4)				\$710.00	
<input type="checkbox"/> International preliminary examination fee (37 CFR 1.482) paid to USPTO and all claims satisfied provisions of PCT Article 33(1)-(4)				\$100.00	
ENTER APPROPRIATE BASIC FEE AMOUNT =				\$890.00 <del>\$0.00</del>	
Surcharge of \$130.00 for furnishing the oath or declaration later than months from the earliest claimed priority date (37 CFR 1.492 (e)). <input type="checkbox"/> 20 <input type="checkbox"/> 30				\$0.00	
CLAIMS	NUMBER FILED	NUMBER EXTRA	RATE		
Total claims	11 - 20 =	0	x \$18.00	\$0.00	
Independent claims	2 - 3 =	0	x \$84.00	\$0.00	
Multiple Dependent Claims (check if applicable). <input type="checkbox"/>				\$0.00	
TOTAL OF ABOVE CALCULATIONS =				\$890.00 <del>\$0.00</del>	
<input type="checkbox"/> Applicant claims small entity status. See 37 CFR 1.27) The fees indicated above are reduced by 1/2.				\$0.00	
SUBTOTAL =				\$890.00 <del>\$0.00</del>	
Processing fee of \$130.00 for furnishing the English translation later than months from the earliest claimed priority date (37 CFR 1.492 (f)) <input type="checkbox"/> 20 <input type="checkbox"/> 30				\$0.00	
TOTAL NATIONAL FEE =				\$890.00 <del>\$0.00</del>	
Fee for recording the enclosed assignment (37 CFR 1.21(h)) The assignment must be accompanied by an appropriate cover sheet (37 CFR 3.28, 3.31) (check if applicable). <input type="checkbox"/>				\$0.00	
TOTAL FEES ENCLOSED =				\$890.00 <del>\$0.00</del>	
				Amount to be refunded	\$
				charged	\$
<p>a. <input checked="" type="checkbox"/> A check in the amount of \$890.00 to cover the above fees is enclosed</p> <p>b. <input type="checkbox"/> Please charge my Deposit Account No. _____ in the amount of _____ to cover the above fees. A duplicate copy of this sheet is enclosed.</p> <p>c. <input checked="" type="checkbox"/> The Commissioner is hereby authorized to charge any additional fees which may be required, or credit any overpayment to Deposit Account No. 13-2855. A duplicate copy of this sheet is enclosed.</p> <p>d. <input type="checkbox"/> Fees are to be charged to a credit card. WARNING: Information on this form may become public. Credit card information should not be included on this form. Provide credit card information and authorization on PTO-2038</p>					
NOTE: Where an appropriate time limit under 37 CFR 1.494 or 1.495 has not been met, a petition to revive (37 CFR 1.137(a) or (b)) must be filed and granted to restore the application to pending status.					
SEND ALL CORRESPONDENCE TO					
<div style="display: flex; justify-content: space-between;"> <div> <p>Richard B. Hoffman Marshall, Gerstein &amp; Borun 6300 Sears Tower 233 South Wacker Drive Chicago, Illinois 60606-6357 Telephone: 312/474-6300 Telecopy: 312 474-0448</p> </div> <div> <p><i>Richard B. Hoffman</i> SIGNATURE</p> <p>Richard B. Hoffman NAME</p> <p>26,910 REGISTRATION NUMBER</p> <p><i>Dec. 7, 2001</i> DATE</p> </div> </div>					

10/009924  
JC05 Rec'd PCT/PTO 07 DEC 2001  
PATENT

Attorney Docket No.: 30051/37969

IN THE UNITED STATES PATENT AND TRADEMARK OFFICE

Applicant: ) "EXPRESS MAIL" mailing label No.  
Ulrich Hege ) EL564464610US Date of Deposit:  
Serial No.: ) December 7, 2001. I hereby certify that  
Filed: ) this paper (or fee) is being deposited with  
Title: CONTROLLER AND METHOD ) the United States Postal Service "EXPRESS  
FOR CONTROLLING THE FLOW OF ) MAIL POST OFFICE TO ADDRESSEE"  
BREWER'S WORT FROM A ) service under 37 CFR §1.10 on the date  
CLARIFYING VAT ) indicated above and is addressed to: U.S.  
Patent and Trademark Office, P.O. Box  
2327, Arlington, VA 22202  
Richard Zimmermann

PRELIMINARY AMENDMENT

U.S. Patent and Trademark Office  
P.O. Box 2327  
Arlington, VA 22202

Sir:

In connection with the subject patent application, please enter the following amendment:

Please change the Title to read: "CONTROLLER AND METHOD FOR CONTROLLING THE FLOW OF BREWER'S WORT FROM A CLARIFYING VAT".

IN THE SPECIFICATION:

At page 1, after the Title, please add a new centered heading as follows:

Field of the Invention

At page 1, please delete first full paragraph and substitute with the following:

The present invention relates to a controller and to a method of controlling the flow of brewer's wort from a clarifying vat by adjusting the height of a raking machine and according

to the turbidity of the outflowing wort.

Page 1, after the first full paragraph, please add a new centered heading as follows:

### Background of the Invention

Page 1, please delete the second full paragraph and substitute with the following:

Such a method for controlling the flow of wort when brewing beer is known e.g. from German Offenlegungsschrift DE 43 24 157 A1. In this method, the actual wort flow is measured and compared with a predetermined desired wort flow. In dependence upon the difference between the actual wort flow and the desired wort flow, the opening of a turning vane and the height of a raking machine are controlled. A wider opening of the control valve will normally lead to an increase in the actual wort flow. A grain bed which has settled on the settling bottom of the lauter tun or clarifying vat is broken up by lowering the raking device; this leads to an increase in the actual wort flow as well. In order to achieve the shortest possible lautering or clarifying time, the desired wort flow is increased in steps with a constant gradient during a trending phase. If, during the trending phase, the desired wort flow increase can be achieved neither by opening the turning vane still further nor by lowering the raking machine because the turning vane is e.g. completely open and because further lowering of the raking machine is not desired, the desired wort flow will be decreased. When the actual wort flow remained constant for a predetermined time or has even increased, the desired wort flow will again be increased in steps with the original gradient.

Page 2, please delete the second full paragraph and substitute with the following:

Although it is impossible to achieve a reduction of the lautering time by the method described in Offenlegungsschrift DE 43 24 157 A1, the lautering or clarifying process still remains, also in the case of this method, the wort-production process which requires the longest time and which should therefore be shortened with regard to a further reduction of the

Page 2, after second full paragraph, please insert a new centered heading as follows:

At page 2, please delete the fourth and fifth full paragraphs.

### Brief Description of the Drawings

Page 4, after description of Figure 9, please insert a new centered heading as follows:

Page 4, please delete last paragraph of page with carryover to page 5, and substitute with the following:

end portion 7 of the drive shaft 6 has secured thereto a plurality of horizontal arms 8 which are equally spaced from one another in the circumferential direction and which each support several raking knives 9 for a grain bed settling as a residue on the settling bottom 10 of the lauter tun 1 during the lautering or clarifying process. The lower end portion 11 of the drive shaft 6 of the raking device is in engagement with the driving device 3 and the lifting and lowering unit 4.

Page 6, please delete the first full paragraph and substitute with the following:

After the control valve 16, the lauter wort 25 flows through a lauter or clarifying vessel 19, a throttle valve 21, a lauter pump 26 and a turbidity sensor 27. The throttle valve 21 is preferably implemented as a butterfly valve. The controller 17 controls the lauter pump 26 and, via a controlling element 22, the throttle valve 21 so as to control the discharge of lauter wort from the lauter vessel 19. If this discharge can be controlled in a sufficiently precise manner by the lauter pump alone, e.g. by repeatedly switching the lauter pump on and off or by controlling the lauter pump speed, the throttle valve 21 and the controlling element 22 can be dispensed with in accordance with another preferred embodiment. For the purpose of pressure compensation, the lauter vessel 19 is additionally connected to the lauter tun 1 via a balance pipe 24. By controlling the flow of wort from the lauter vessel 19, the level of the wort 20 in the lauter vessel 19 can be controlled independently of the amount flowing in. The difference between the water level in the lauter tun 1 and the lauter wort level in the lauter vessel 19 generates a pressure difference which forces the water in the lauter tun through the grain bed that has settled on the bottom of the lauter tun. It follows that this differential pressure and, consequently, the actual wort flow from the lauter tun 1 can be controlled by varying the level of the lauter wort 20 in the lauter vessel 19.

Page 6, please delete the second full paragraph and substitute with the following:

Line 22 connects the lauter tun 1 to a mash tun or mash fermenting vat.

Page 6, please delete the third full paragraph and substitute with the following:

The device shown in Fig. 1 can be used for executing the method according to the present invention. Fig. 2 to 9 show lautering processes of eight different brews, the first wort being subjected to lautering or clarifying first, whereupon a second wort follows. The total wort quantity amounts to 350 hl in each case. Normally, the following equations are used for calculating from the process data the amounts of total wort, first wort, second wort and sparge water.

At top of page 16, please add a new centered heading as follows:

### “English” Legends for the Drawing Figures

#### IN THE CLAIMS:

Please delete Claims at top of page and insert I Claim.

Please amend the claims to read as follows:

1 (Amended). A device for controlling the flow of wort from a lauter tun, comprising a fuzzy controller.

2 (Amended). A method of controlling the flow of wort (15) from a lauter tun (1), comprising the steps of:

controlling a control vale (16) and a height of a raking machine (5) in dependence upon a difference between a desired wort flow and an actual wort flow,

opening further the control valve (16) and lowering further the raking machine (5) if the desired wort flow is less than the actual wort flow and vice-versa;

reducing the desired wort flow if a further increase in the actual wort flow is not to be caused by further opening of the control valve (16) or lowering of the raking machine (5); and

additionally adjusting the desired wort flow and the height of the raking machine (5)

44 45 46 47 48 49 50 51 52 53 54 55 56 57 58 59 60 61 62 63 64 65 66 67 68 69 70 71 72 73 74 75 76 77 78 79 80 81 82 83 84 85 86 87 88 89 90 91 92 93 94 95 96 97 98 99 100 101 102 103 104 105 106 107 108 109 110 111 112 113 114 115 116 117 118 119 120 121 122 123 124 125 126 127 128 129 130 131 132 133 134 135 136 137 138 139 140 141 142 143 144 145 146 147 148 149 150 151 152 153 154 155 156 157 158 159 160 161 162 163 164 165 166 167 168 169 170 171 172 173 174 175 176 177 178 179 180 181 182 183 184 185 186 187 188 189 190 191 192 193 194 195 196 197 198 199 200 201 202 203 204 205 206 207 208 209 210 211 212 213 214 215 216 217 218 219 220 221 222 223 224 225 226 227 228 229 230 231 232 233 234 235 236 237 238 239 240 241 242 243 244 245 246 247 248 249 250 251 252 253 254 255 256 257 258 259 260 261 262 263 264 265 266 267 268 269 270 271 272 273 274 275 276 277 278 279 280 281 282 283 284 285 286 287 288 289 290 291 292 293 294 295 296 297 298 299 300 301 302 303 304 305 306 307 308 309 310 311 312 313 314 315 316 317 318 319 320 321 322 323 324 325 326 327 328 329 330 331 332 333 334 335 336 337 338 339 340 341 342 343 344 345 346 347 348 349 350 351 352 353 354 355 356 357 358 359 360 361 362 363 364 365 366 367 368 369 370 371 372 373 374 375 376 377 378 379 380 381 382 383 384 385 386 387 388 389 390 391 392 393 394 395 396 397 398 399 400 401 402 403 404 405 406 407 408 409 410 411 412 413 414 415 416 417 418 419 420 421 422 423 424 425 426 427 428 429 430 431 432 433 434 435 436 437 438 439 440 441 442 443 444 445 446 447 448 449 450 451 452 453 454 455 456 457 458 459 460 461 462 463 464 465 466 467 468 469 470 471 472 473 474 475 476 477 478 479 480 481 482 483 484 485 486 487 488 489 490 491 492 493 494 495 496 497 498 499 500 501 502 503 504 505 506 507 508 509 510 511 512 513 514 515 516 517 518 519 520 521 522 523 524 525 526 527 528 529 530 531 532 533 534 535 536 537 538 539 540 541 542 543 544 545 546 547 548 549 550 551 552 553 554 555 556 557 558 559 560 561 562 563 564 565 566 567 568 569 570 571 572 573 574 575 576 577 578 579 580 581 582 583 584 585 586 587 588 589 590 591 592 593 594 595 596 597 598 599 600 601 602 603 604 605 606 607 608 609 610 611 612 613 614 615 616 617 618 619 620 621 622 623 624 625 626 627 628 629 630 631 632 633 634 635 636 637 638 639 640 641 642 643 644 645 646 647 648 649 650 651 652 653 654 655 656 657 658 659 660 661 662 663 664 665 666 667 668 669 670 671 672 673 674 675 676 677 678 679 680 681 682 683 684 685 686 687 688 689 690 691 692 693 694 695 696 697 698 699 700 701 702 703 704 705 706 707 708 709 710 711 712 713 714 715 716 717 718 719 720 721 722 723 724 725 726 727 728 729 730 731 732 733 734 735 736 737 738 739 740 741 742 743 744 745 746 747 748 749 750 751 752 753 754 755 756 757 758 759 760 761 762 763 764 765 766 767 768 769 770 771 772 773 774 775 776 777 778 779 780 781 782 783 784 785 786 787 788 789 790 791 792 793 794 795 796 797 798 799 800 801 802 803 804 805 806 807 808 809 810 811 812 813 814 815 816 817 818 819 820 821 822 823 824 825 826 827 828 829 830 831 832 833 834 835 836 837 838 839 840 841 842 843 844 845 846 847 848 849 850 851 852 853 854 855 856 857 858 859 860 861 862 863 864 865 866 867 868 869 870 871 872 873 874 875 876 877 878 879 880 881 882 883 884 885 886 887 888 889 890 891 892 893 894 895 896 897 898 899 900 901 902 903 904 905 906 907 908 909 910 911 912 913 914 915 916 917 918 919 920 921 922 923 924 925 926 927 928 929 930 931 932 933 934 935 936 937 938 939 940 941 942 943 944 945 946 947 948 949 950 951 952 953 954 955 956 957 958 959 960 961 962 963 964 965 966 967 968 969 970 971 972 973 974 975 976 977 978 979 980 981 982 983 984 985 986 987 988 989 990 991 992 993 994 995 996 997 998 999 1000 1001 1002 1003 1004 1005 1006 1007 1008 1009 1010 1011 1012 1013 1014 1015 1016 1017 1018 1019 1020 1021 1022 1023 1024 1025 1026 1027 1028 1029 1030 1031 1032 1033 1034 1035 1036 1037 1038 1039 1040 1041 1042 1043 1044 1045 1046 1047 1048 1049 1050 1051 1052 1053 1054 1055 1056 1057 1058 1059 1060 1061 1062 1063 106

3 (Amended). A method according to claim 2, and taking into account both the change with time of the position of the control valve (16) as an input variable, and that fast opening of the control valve (16) leads to a decrease in the desired wort flow and to a lowering of the raking machine.

4 (Amended). A method according to claim 2, and increasing the inflow of sparge water above the actual wort flow, if the actual wort flow remains below the desired wort flow during a second wort, and reducing the inflow of sparge water as soon as the actual wort flow approaches the desired wort flow.

5 (Amended). A method according to claim 2, and lowering a level in a lauter vessel (19), if the actual wort flow remains below the desired wort flow.

6 (Amended). A method according to claim 2, and reducing the sparge water quantity in the case of easy-running brews.

7 (Amended). A method according to claim 2, and taking into account, for triggering a deep cut, the position of the control valve (16), the actual wort flow (15), the height of the raking machine (5) and the turbidity.

8 (Amended). A method according to claim 2, wherein, if the raking machine (5) has not been moved below a certain level during the first wort, moving the raking machine (5) at least once to a low position during a second wort.

9 (Amended). A method according to claim 2, and reducing the lautered amount of first wort, if a brew runs poorly during lautering of the first wort.

10 (Amended). A method according to claim 2, wherein the poorer the second wort runs, the later the trub is added during a second wort.



[illegible]

lauter vessel occurs at the end of lautering a first wort.

## REMARKS

added.

show changes made”.

please charge our deposit account No. 13-2855.

Respectfully submitted,

Ulrich Hege, Applicant

Date: December 7, 2001

By Richard B. Hoffman  
Richard B. Hoffman, Reg. No. 26,910  
Attorney for Applicant

Marshall, Gerstein & Borun  
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233 South Wacker Drive  
Chicago, Illinois 60606-6357  
Telephone: 312/474-6300  
Telecopy: 312/474-0448

## Abstract

A controller for controlling the flow of wort from a lauter tun in the form of a fuzzy controller. A method of controlling the flow of wort from a later tun, comprising the steps of controlling a control valve and a height of a raking machine in dependence upon a difference between a desired wort flow and an actual wort flow, the control valve being opened further and the raking machine being lowered further if the desired wort flow is less than the actual wort flow and vice-versa; reducing the desired wort flow if a further increase in the actual wort flow is not to be caused by further opening of the control valve or lowering of the raking machine; and adjusting the desired wort flow and the height of the raking machine in dependence upon the turbidity of the outflowing wort so that an increase in turbidity will result in a less substantial lowering of the raking machine and a lower desired wort flow.

VERSION WITH MARKINGS TO SHOW CHANGES MADE

Please change the Title to read: "CONTROLLER AND METHOD FOR CONTROLLING THE FLOW OF BREWER'S WORT FROM A CLARIFYING VAT".  
IN THE SPECIFICATION:

At page 1, after the Title, please add a new centered heading as follows:

Field of the Invention

At page 1, please delete first full paragraph and substitute with the following:

The present invention relates to a controller and to a method of "the type referred to in the generic clauses of claims 1 and 2." --controlling the flow of brewer's wort from a clarifying vat by adjusting the height of a raking machine and according to the turbidity of the outflowing wort.--

Page 1, after the first full paragraph, please add a new centered heading as follows:

Background of the Invention

Page 1, please delete the second full paragraph and substitute with the following:

Such a method for controlling the flow of wort when brewing beer is known e.g. from German Offenlegungsschrift DE 43 24 157 A1. In this method, the actual wort flow is measured and compared with a predetermined desired wort flow. In dependence upon the difference between the actual wort flow and the desired wort flow, the opening of a turning vane and the height of a raking machine are controlled. A wider opening of the control valve will normally lead to an increase in the actual wort flow. A grain bed which has settled on the settling bottom of the lauter tun --or clarifying vat-- is broken up by lowering the raking device; this leads to an increase in the actual wort flow as well. In order to achieve the shortest possible lautering --or clarifying-- time, the desired wort flow is increased in steps with a constant gradient during a trending phase. If, during the trending phase, the desired

wort flow increase can be achieved neither by opening the turning vane still further nor by lowering the raking machine because the turning vane is e.g. completely open and because further lowering of the raking machine is not desired, the desired wort flow will be decreased. When the actual wort flow remained constant for a predetermined time or has even increased, the desired wort flow will again be increased in steps with the original gradient.

Page 2, please delete the second full paragraph and substitute with the following:

Although it is impossible to achieve a reduction of the lautering time by the method described in Offenlegungsschrift DE 43 42 157 A1, the lautering --or clarifying-- process still remains, also in the case of this method, the wort-production process which requires the longest time and which should therefore be shortened with regard to a further reduction of the brewing period resulting in a higher number of brewing steps per unit time. This should be done without impairing the wort quality. Furthermore, it is desirable that it should, as far as possible, not be necessary to adapt a controller and a method for controlling the flow of wort from a lauter tun --or clarifying vat-- to various types of beer, feedstock compositions, compositions of rough-ground material, mash consistencies and lauter tun charges. On the contrary, the controller and the method should adapt automatically to a great variety of types of beer, feedstock compositions, etc., by taking into account important parameters.

Page 2, after second full paragraph, please insert a new centered heading as follows:

#### Summary of the Invention

At page 2, please delete the fourth and fifth full paragraphs.

At top of page 4, please insert a new centered heading as follows:

#### Brief Description of the Drawings

Page 4, after description of Figure 9, please insert a new centered heading as follows:

#### Detailed Description of the Invention

Page 4, please delete last paragraph of page with carryover to page 5, and substitute with the following:

Fig. 1 shows a device in which the controller according to the present invention and the method according to the present invention are preferably used. The device comprises a lauter tun --or clarifying vat-- 1, which can be arranged on a support, not shown, so as to provide below the bottom 2 of the lauter tun 1 a space for installing a driving device 3 as well as a lifting and lowering unit 4 for the raking machine 5 arranged within the lauter tun 1. The drive motors for the lifting and lowering unit as well as for the rotary movement of the raking machine are designed by reference symbol M. The raking machine 5 is provided with a drive shaft 6 which is supported such that it is rotatable as well as axially displaceable. The upper end portion 7 of the drive shaft 6 has secured thereto a plurality of horizontal arms 8 which are equally spaced from one another in the circumferential direction and which each support several raking knives 9 for a grain bed settling as a residue on the settling bottom 10 of the lauter tun 1 during the lautering --or clarifying-- process. The lower end portion 11 of the drive shaft 6 of the raking device is in engagement with the driving device 3 and the lifting and lowering unit 4.

Page 6, please delete the first full paragraph and substitute with the following:

After the control valve 16, the lauter wort 25 flows through a lauter --or clarifying-- vessel 19, a throttle valve 21, a lauter pump 26 and a turbidity sensor 27. The throttle valve 21 is preferably implemented as a butterfly valve. The controller 17 controls the lauter pump 26 and, via a controlling element 22, the throttle valve 21 so as to control the discharge of lauter wort from the lauter vessel 19. If this discharge can be controlled in a sufficiently precise manner by the lauter pump alone, e.g. by repeatedly switching the lauter pump on and off or by controlling the lauter pump speed, the throttle valve 21 and the controlling element

22 can be dispensed with in accordance with another preferred embodiment. For the purpose of pressure compensation, the lauter vessel 19 is additionally connected to the lauter tun 1 via a balance pipe 24. By controlling the flow of wort from the lauter vessel 19, the level of the wort 20 in the lauter vessel 19 can be controlled independently of the amount flowing in. The difference between the water level in the lauter tun 1 and the lauter wort level in the lauter vessel 19 generates a pressure difference which forces the water in the lauter tun through the grain bed that has settled on the bottom of the lauter tun. It follows that this differential pressure and, consequently, the actual wort flow from the lauter tun 1 can be controlled by varying the level of the lauter wort 20 in the lauter vessel 19.

Page 6, please delete the second full paragraph and substitute with the following:

Line 22 connects the lauter tun 1 to a mash tun --or mash fermenting vat--.

Page 6, please delete the third full paragraph and substitute with the following:

The device shown in Fig. 1 can be used for executing the method according to the present invention. Fig. 2 to 9 show lautering processes of eight different brews, the first wort being subjected to lautering --or clarifying-- first, whereupon a second wort follows. The total wort quantity amounts to 350 hl in each case. Normally, the following equations are used for calculating from the process data the amounts of total wort, first wort, second wort and sparge water.

At top of page 16, please add a new centered heading as follows:

“English” Legends for the Drawing Figures

# IN THE CLAIMS:

Please delete Claims at top of page and insert I Claim.

Please amend the claims to read as follows:

1 (Amended). A [controller] device for controlling the flow of wort from a lauter tun,



5 (Amended). A method according to [one of the] claim[s] 2 [to 4, characterized in that, in addition,], and lowering a level in a lauter vessel (19) [will be lowered], if the actual wort flow remains below the desired wort flow[, especially if the end of the lautering of a first wort is at hand].

6 (Amended). A method according to [one of the] claim[s] 2 [to 5, characterized in that], and reducing the sparge water quantity [will be reduced] in the case of easy-running brews.

7 (Amended). A method according to [one of the] claim[s] 2 [to 6, characterized in that], and taking into account, for triggering a deep cut, the position of the control valve (16), the actual wort flow (15), the height of the raking machine (5) and the turbidity [are taken into account].

8 (Amended). A method according to [one of the] claim[s] 2 [to 7, characterized in that], wherein, if the raking machine (5) has not been moved below a certain level during the first wort, moving the raking machine (5) [will be moved] at least once to a low position during a second wort.

9 (Amended). A method according to [one of the] claim[s] 2 [to 8], [characterized in that] and reducing the lautered amount of first wort [will be reduced], if a brew runs poorly during lautering of the first wort.

10 (Amended). A method according to [one of the] claim[s] 2 [to 9, characterized in that], wherein the poorer the second wort runs, the later [will] the trub [be] is added during a second wort.

Please add the following new claim:

11. A method according to claim 5, and wherein said step of lowering a level in the lauter vessel occurs at the end of lautering a first wort.



## Abstract

A controller for controlling the flow of wort from a lauter tun[, said controller being] in the form of a fuzzy controller. A method of controlling the flow of wort from a lauter tun, [said method] comprising the [following] steps[:] of controlling a control valve and a height of a raking machine in dependence upon a difference between a desired wort flow and an actual wort flow, the control valve being opened further and the raking machine being lowered further if the desired wort flow is less than the actual wort flow and vice-versa; reducing the desired wort flow if a further increase in the actual wort flow is not to be caused by further opening of the control valve or lowering of the raking machine; and adjusting the desired wort flow and the height of the raking machine in dependence upon the turbidity of the outflowing wort so that an increase in turbidity will result in a less substantial lowering of the raking machine and a lower desired wort flow.

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[Fortsetzung auf der nächsten Seite]

(54) Title: CONTROLLER AND METHOD FOR CONTROLLING THE FLOW OF BREWER'S WORT FROM A CLARIFYING VAT

(54) Bezeichnung: REGLER UND VERFAHREN ZUR STEUERUNG DES WÜRZEABFLUSSES AUS EINEM LÄUTERBOTTICH

(57) Abstract: The invention relates to a controller which is used to control the flow of brewer's wort from a clarifying vat, whereby said controller is a fuzzy controller. The invention also relates to a method for controlling the flow of brewer's wort from a clarifying vat, comprising the following steps: a control valve and the height of a picking machine are adjusted according to the difference between a desired wort flow and an actual wort flow, whereby the control valve is opened further or the picking machine is lowered further if the desired wort flow is less than the actual wort flow and vice-versa; the desired wort flow is reduced if the actual wort flow is not to be increased by further opening of the control valve or lowering of the picking machine; the desired wort flow and height of the picking machine are adjusted according to the turbidity of the outflowing wort so that an increase in turbidity results in a less substantial lowering of the picking machine and a lower desired wort flow.

(57) Zusammenfassung: Regler zur Steuerung des Würzeabflusses aus einem Läuterbottich, wobei der Regler ein Fuzzy-Regler ist. Verfahren zur Steuerung des Würzeabflusses aus einem Läuterbottich, das die folgenden Vorgänge umfasst: Regeln eines Regelventils und einer Höhe einer Aufackmaschine abhängig von einem Unterschied zwischen einem Sollwürzefluss und einem Istwürzefluss, wobei das Regelventil weiter geöffnet oder die Aufackmaschine weiter abgesenkt wird, falls der Sollwürzefluss unter dem Istwürzefluss liegt und umgekehrt; Reduzieren des Sollwürzefflusses, falls weder durch weiteres Öffnen des Regelventils noch durch Absenken der Aufackmaschine eine weitere Erhöhung des Istwürzefflusses erwünscht ist; Einstellen des Sollwürzefflusses und der Höhe der Aufackmaschine in Abhängigkeit der Trübung der abfließenden Würze, so dass eine Erhöhung der Trübung zu einem weniger starken Absenken der Aufackmaschine und zu einem geringeren Sollwürzeffluss führt.

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## **Controller and method for controlling the flow of wort from a lauter tun**

The present invention relates to a controller and to a method of the type referred to in the generic clauses of claims 1 and 2.

Such a method for controlling the flow of wort when brewing beer is known e.g. from German Offenlegungsschrift DE 43 24 157 A1. In this method, the actual wort flow is measured and compared with a predetermined desired wort flow. In dependence upon the difference between the actual wort flow and the desired wort flow, the opening of a turning vane and the height of a raking machine are controlled. A wider opening of the control valve will normally lead to an increase in the actual wort flow. A grain bed which has settled on the settling bottom of the lauter tun is broken up by lowering the raking device; this leads to an increase in the actual wort flow as well. In order to achieve the shortest possible lautering time, the desired wort flow is increased in steps with a constant gradient during a trending phase. If, during the trending phase, the desired wort flow increase can be achieved neither by opening the turning vane still further nor by lowering the raking machine because the turning vane is e.g. completely open and because further lowering of the raking machine is not desired, the desired wort flow will be decreased. When the actual wort flow remained constant for a predetermined time or has even increased, the desired wort flow will again be increased in steps with the original gradient.

In addition, the fuzzy logic is known from the prior art. Taking as a basis the theory of fuzzy sets, which was established by Zadeh in 1965, the vague, subjective and equivocal concepts of human thinking can be replicated by algorithms. In contrast to the classic set theory, where each element belongs or does not belong to a specific set, the individual elements of the fuzzy set can also belong to said fuzzy set to a certain degree of membership, which is normally in the interval between 0 and 1. In this case, degree 1 means full membership to the set considered and degree 0 means non-membership. Between these values there is a continuous transition from "being an element" to "not being an element".

Essential elements of the fuzzy logic are the so-called linguistic variables. Their values are not figures, but expressions of informal speech. Since words are less precise than figures, the individual values are represented by fuzzy sets.

When the fuzzy logic is used in a control process, all input variables are first fuzzified. Each input variable defines a linguistic variable on the measurement range of which so-called fuzzy sets are defined. During the fuzzification the degree of membership to the fuzzy sets is determined. By means of a knowledge base, a degree of membership on a set of each output variable is determined on the basis of the fuzzified input variables. The knowledge base is stored in the form of if-then values. The degrees of membership to the output variables are accumulated so as to form an output set. The fuzzy output set is de-fuzzified via the centroid and its point of intersection with the axis of the output variable, whereby a precise value for each output variable is obtained.

Although it is impossible to achieve a reduction of the lautering time by the method described in Offenlegungsschrift DE 43 42 157 A1, the lautering process still remains, also in the case of this method, the wort-production process which requires the longest time and which should therefore be shortened with regard to a further reduction of the brewing period resulting in a higher number of brewing steps per unit time. This should be done without impairing the wort quality. Furthermore, it is desirable that it should, as far as possible, not be necessary to adapt a controller and a method for controlling the flow of wort from a lauter tun to various types of beer, feedstock compositions, compositions of rough-ground material, mash consistencies and lauter tun charges. On the contrary, the controller and the method should adapt automatically to a great variety of types of beer, feedstock compositions etc., by taking into account important parameters.

It is therefore the object of the present invention to provide a controller and a method in the case of which lautering from a lauter tun is accelerated with due regard to the experience of those skilled in the art.

This object is achieved by claims 1 and 2.

Preferred embodiments are the subject matters of the subclaims.

Taking into account the change with time of the position of the control valve is advantageous insofar as the raking machine will react faster, whereby the stroke lengths of the

raking machine will be reduced substantially. This will especially prevent the raking machine from being lowered to a very low level, which would lead to higher turbidity of the wort.

When the turbidity of the outflowing wort is taken into account, preferably in connection with the change with time of the turning vane, this will offer the advantage that the raking machine will travel to constantly varying heights and, especially, that the zigzag knives will not always move along the same tracks.

A smaller water buffer on the grain bed is additionally advantageous insofar as a higher concentration gradient will be obtained, and this will lead to an improved yield.

A lowering of the level in a lauter vessel leads to increase in the differential pressure at the grain bed and thus, advantageously, to an increase in the actual wort flow. By lowering the level in the lauter vessel gradually, a sudden suction effect on the grain bed will be avoided.

A reduction of the sparge water quantity in the case of easy-running brews is advantageous insofar as a future draining time will be reduced.

In the case of poor-running brews, the lautering process can be shortened by prematurely stopping the first wort or a second wort, especially when a raking inhibitor has already been activated.

A forced lowering of the raking machine to a low position, if the raking machine has not moved below a certain level during the first wort, will advantageously lead to a better washing out of the extract.

When the change with time of the position of the turning vane as well as the instantaneous position of the raking machine are taken into account, a premature raising of the actual wort flow will be avoided in an advantageous manner. This would lead to a lowering of the raking machine and thus to an increase in the turbidity of the wort, which would be detected by a turbidity sensor only with a certain delay.

The present invention is additionally advantageous insofar as the lautering time is automatically optimized in accordance with the individual, special characteristics of a brew.

Fig. 1 shows a schematic representation of a lauter tun provided with a controller according to the present invention,

Fig. 3 shows a lautering process with a first wort which does not run very well towards the end of the process and with a poor-running second wort,

Fig. 5 shows a lautering process in which the level in a lauter vessel is not raised completely until the actual wort flow has recovered during the second wort,

Fig. 7 shows a lauter process in which the first wort runs poorly towards the end of the process and the second wort runs poorly towards the end of the process, and in which sparging was carried out once more during the second wort,

Fig. 9 shows a lautering process in which, due to the high turbidity, the raking machine moves to a level which is not as low as the level in Fig. 8.

Fig. 1 shows a device in which the controller according to the present invention and the method according to the present invention are preferably used. The device comprises a

lauter tun 1, which can be arranged on a support, not shown, so as to provide below the bottom 2 of the lauter tun 1 a space for installing a driving device 3 as well as a lifting and lowering unit 4 for the raking machine 5 arranged within the lauter tun 1. The drive motors for the lifting and lowering unit as well as for the rotary movement of the raking machine are designated by reference symbol M. The raking machine 5 is provided with a drive shaft 6 which is supported such that it is rotatable as well as axially displaceable. The upper end portion 7 of the drive shaft 6 has secured thereto a plurality of horizontal arms 8 which are equally spaced from one another in the circumferential direction and which each support several raking knives 9 for a grain bed settling as a residue on the settling bottom 10 of the lauter tun 1 during the lautering process. The lower end portion 11 of the drive shaft 6 of the raking device is in engagement with the driving device 3 and the lifting and lowering unit 4.

The lauter wort 1 drawn off from the lauter tun 1 flows via an outlet 12 into the collecting vessel 13 and from said collecting vessel 13 into a central tube 14 which is followed by a flowmeter 15 and a control valve 16. The control valve 16 is preferably implemented as a turning vane; it is controlled by the controlling element 18. The flowmeter 15 is used for measuring the actual wort flow of the lauter wort.

The flowmeter 15 and the turbidity sensor 27 are connected to the controller 17, which is, in turn, connected to the controlling element 18, the turning vane 16 and the driving device 3 of the lifting and lowering unit of the raking device 5. In accordance with a further preferred embodiment, the controller 17 additionally controls the lauter pump 26 and the controlling element 22 of the butterfly valve 21. In accordance with another preferred embodiment, the controller 17 controls via the valve 28 the supply of sparge water through the supply line 23. The inflow of sparge water can be determined by the position of said valve 28. In accordance with a further preferred embodiment, the supply line 23 has installed therein a further flowmeter so as to permit a more precise determination of the amount and of the flow of sparge water.

With the aid of the pressure sensors  $p_1$  and  $p_2$ , a pressure drop at the grain bed is measured. This pressure drop is referred to as spent grains resistance. The spent grains resistance provides for the lautering process an information value similar to that provided by an actual wort flow measurement through the flowmeter 15. In order to save costs and in view of the fact that the two pressure cells serving a pressure sensors are easily damaged, the

spent grains resistance measured by means of the pressure sensors  $p_1$  and  $p_2$  can either be additionally taken into account in the case of said preferred embodiment or the measurement of said spent grains resistance can be dispensed with. Easy-running brews have a low spent grain resistance, whereas poor-running brews have a high spent grains resistance.

After the control valve 16, the lauter wort 25 flows through a lauter vessel 19, a throttle valve 21, a lauter pump 26 and a turbidity sensor 27. The throttle valve 21 is preferably implemented as a butterfly valve. The controller 17 controls the lauter pump 26 and, via a controlling element 22, the throttle valve 21 so as to control the discharge of lauter wort from the lauter vessel 19. If this discharge can be controlled in a sufficiently precise manner by the lauter pump alone, e.g. by repeatedly switching the lauter pump on and off or by controlling the lauter pump speed, the throttle valve 21 and the controlling element 22 can be dispensed with in accordance with another preferred embodiment. For the purpose of pressure compensation, the lauter vessel 19 is additionally connected to the lauter tun 1 via a balance pipe 24. By controlling the flow of wort from the lauter vessel 19, the level of the wort 20 in the lauter vessel 19 can be controlled independently of the amount flowing in. The difference between the water level in the lauter tun 1 and the lauter wort level in the lauter vessel 19 generates a pressure difference which forces the water in the lauter tun through the grain bed that has settled on the bottom of the lauter tun. It follows that this differential pressure and, consequently, the actual wort flow from the lauter tun 1 can be controlled by varying the level of the lauter wort 20 in the lauter vessel 19.

Line 22 connects the lauter tun 1 to a mash tun.

The device shown in Fig. 1 can be used for executing the method according to the present invention. Fig. 2 to 9 show lautering processes of eight different brews, the first wort being subjected to lautering first, whereupon a second wort follows. The total wort quantity amounts to 350 hl in each case. Normally, the following equations are used for calculating from the process data the amounts of total wort, first wort, second wort and sparge water:

$$\text{total wort (hl)} = S \cdot AF(P_{fv} \cdot (P_{fv} \cdot 0.004 / 0.998))$$

$$\text{quantity VM (hl)} =: HG / S \cdot 0.64 \text{ (hl/dT)} / SW - TF \cdot S$$



quantity second wort (hl) total wort (hl) – quantity VW  
(hl)

quantity sparge water (hl): total wort (hl) – HG / S\*AF

-S: grist (dT) from process data

-AF: yield factor (% 100) approx. 0.76

-Pfv: predetermined data for full wort concentration (GG%)

-HG: main wort (hl) from process data

-SW: rinsing water (hl) from process data

-TF: specific factor for spent grains volume (hl/dT) approx. 1.80

-AF: sparge water factor (hl/dT) approx. 0.5

The time, in minutes, that has elapsed since the beginning of the lautering process is plotted along the X axes of all diagrams in Fig. 2 to 9. The respective upper diagram shows the actual wort flow 50, the desired wort flow 51 and the height of the raking machine 52 against time. In the respective middle diagrams, the actual wort flow 50, the sparge water quantity 53 and the sparge water flow 54 are plotted in arbitrary units. In the lower diagrams, the lautered wort 55, in hectolitres (hl), is plotted against time, the opening of the control valve 56, in percent, is plotted against time, and the level 57 in the lauter vessel 19, in arbitrary units, is plotted against time. Furthermore, it is indicated after how many hectolitres of lautered wort the trub is added.

In accordance with a preferred embodiment of the present invention, the height of the raking machine is influenced by the turbidity measured by the turbidity sensor 27. The deeper the raking machine cuts into the grain bed, the poorer the filtering effect of the grain bed and the more turbid the lautered wort. Hence, the method according to the present invention and a preferred embodiment of the controller according to the present invention control the height of the raking machine in dependence upon the turbidity of the outflowing wort so that an increase in turbidity will lead to a reduction of the degree to which the raking machine is lowered. A reduction of the raking depth of the grain bed leads, in the final analysis, also to a reduction of the actual wort flow. Since, in the case of an unchanged desired wort flow, a reduced actual wort flow would lead to a lowering of the raking machine, the desired wort flow is reduced as well. In Fig. 8 and 9, the actual wort flow collapses abruptly at points 171 and 182. In Fig. 8 the turbidity is 43 EBC, whereas in Fig. 9 it is 87 EBC. It follows that the raking machine 171 moves down to a lower level at 171 in Fig. 8 than at 182 in Fig. 9.

As long as the second wort runs poorly on the other side, the sparge water flow is chosen such that it exceeds the actual wort flow; this contributes to an increase of the water buffer on the grain bed and therefore, via a higher pressure difference, to an increase of the actual

wort flow. The larger water buffer has the effect that the upper part of the grain bed is softened whereby the spent grains resistance will be reduced still further.

In addition, the level of the wort 20 in a lauter vessel is slightly lowered, especially when the water buffer is small, so as to increase the actual wort flow by a higher pressure difference between the lauter tun and the lauter vessel. Especially towards the end of the first wort, the level in the lauter vessel 19 is lowered so as to maintain a sufficient pressure difference between the lauter tun 1 and the lauter vessel 19 and, consequently, an acceptable actual wort flow. A sudden suction effect on the grain bed is avoided by gradually lowering the level in the lauter vessel 19. This is shown in Fig. 6 especially at 151. During a second wort, which follows the first wort, the level in the lauter vessel 19 will not be fully raised until the sparge water supplied has formed a water buffer of sufficient thickness on the grain bed so that the pressure difference between the lauter tun 1 and the lauter vessel 19 will be sufficiently high for raising the actual wort flow approximately to the desired wort flow. This is shown in Fig. 5 at 142.

In the case of easy-running brews, the sparge water quantity resulting from the above formulae is preferably reduced to a certain extent so as to reduce the draining time later on. In Fig. 2, the sparge water quantity amounts to 172 hl and the sparge water flow is less than the actual wort flow during the whole second wort. In Fig. 4, the sparge water quantity amounts to 171 hl. The spent grains resistance decreases here only towards the end of the second wort. The decrease is so substantial that a smaller amount of sparge water suffices. The reverse case is shown in Fig. 3. Since the spent grains resistance was low at the beginning and in the middle of the second wort, i.e. since the brew ran well at the beginning, the sparge water quantity was to be reduced. Since the brew had, however, a high spent grains resistance towards the end of the second wort, sparging was carried out once more (124). The sparge water quantity amounts here to 179 hl. A similar lautering process in which sparging was carried out once more at 161 is shown in Fig. 7. The sparge water quantity amounted here to 180 hl.

In accordance with the present invention, deep cutting is preferably not only caused by the fact that the actual wort flow falls below a certain limit value, but the factors taken into account are preferably the deviation of the actual wort flow from the desired wort flow, the position of the control valve 16, the relative height of the actual wort flow, the height of the

raking machine and the turbidity. The locations at which deep cuts are caused are not shown in Fig. 2 to 9.

According to the present invention also the quantity of the first wort is variable to a certain extent. When e.g. a raking inhibitor, which prevents deep cutting, has already been activated and when only a few hectolitres have to be lautered and the actual wort flow becomes undesirably low, the first wort will be stopped prematurely. Fig. 2 shows a lautering process in which the first wort runs well and in which the whole first wort of e.g. 150 hl is therefore lautered. Fig. 3 shows a lautering process in which the first wort does not run very well towards the end of the process so that the first wort quantity is slightly reduced to e.g. 147 hl. Fig. 7 shows a lautering process in which the first wort runs poorly at the end of the process and in which the first wort quantity is reduced still further to e.g. 143 hl.

Also in the case of easy-running brews, raking at a low position (Fig. 2, 111) is preferably performed so as to improve the washing out of the grain bed during the second wort, if the raking machine has not moved below a certain level during the first wort.

The moment at which the trub is added is preferably determined in dependence upon the spent grains resistance. If the spent grains resistance is high at the beginning of the second wort, the trub will be added later. Fig. 2 shows a lautering process in which the spent grains resistance is low at the beginning of the second wort and in which the trub is therefore already added when 179 hl lauter wort have been lautered. Fig. 5 shows a lautering process in which the spent grains resistance is high at the beginning of the second wort, i.e. in which the second wort runs poorly at the beginning; the trub is therefore not added until 210 hl lauter wort have been lautered.

In addition, the actual wort flow is preferably chosen in dependence upon the change with time of the control valve 16 and the height of the raking machines. The actual wort flow is in particular not increased as long as the raking machine still moves at a low position, so as to avoid an excessive turbidity of the lauter wort. In Fig. 7 the actual wort flow is not increased at 162, although the actual wort flow and the desired wort flow correspond, because the raking machine still moves at a low position and the control valve 16 is in the process of opening quickly.

If the actual wort flow lags behind the desired wort flow, the pressure difference between the lauter tun 1 and the lauter vessel 19 will be increased by feeding CO<sub>2</sub> into the lauter tun in accordance with another preferred embodiment. As far as the actual flow is concerned, a feeding of CO<sub>2</sub> produces an effect similar to that of a thicker water buffer caused by an increased inflow of sparge water or a lowering of the level in the lauter vessel 19. When CO<sub>2</sub> is fed into the lauter tun, the balance pipe is preferably closed so as to prevent pressure compensation with the lauter vessel 19.

The controller according to the present invention and the method according to the present invention use preferably nine input variables, viz. the difference between the desired wort flow and the actual wort flow, the actual wort flow, the change with time of the control valve position, the control valve position, the lauter quantity, the turbidity of the lauter wort, the sparge water quantity, the height of the raking machine, and a Boolean variable which indicates whether the raking machine has once been moved to a low position during the first wort. The controller according to the present invention and the method according to the present invention produce eight output values, viz. the inflow of sparge water (hl/h), the desired wort flow, the height of the raking machine, the fine adjustment of the height of the raking machine, the level in the lauter vessel, a trigger for the termination of the first wort, a trigger for the addition of trub and a trigger for a deep cut.

The method according to the present invention is preferably implemented by means of a fuzzy controller which operates according to the max-prod interference mechanism and which applies the next-centroid method for de-fuzzification. In addition, an old value will be maintained, if no rule is active.

Since outputs are fed back to inputs in accordance with the method according to the present invention, the output values of the controller are kept constant e.g. for two minutes at the beginning of the lautering process so as to prevent wild transients when the lautering process begins. In accordance with other preferred embodiments, various outputs of the controller begin to vary the constant values according to the control method after different periods of time. For example, one minute after the beginning of the lautering process a control of the actual wort flow is started, in which the actual wort flow is controlled by means of the control valve 16 such that it corresponds to desired wort flow, whereas the height of

the raking machine is not changed until another four minutes have elapsed. After five minutes more, the level in the lauter vessel 19 is included in the control as well.

## Claims

1. A controller for controlling the flow of wort from a lauter tun, **characterized in that** the controller is a fuzzy controller.

2. A method of controlling the flow of wort (15) from a lauter tun (1), which comprises the following steps:

controlling a control valve (18) and a height of a raking machine (5) in dependence upon a difference between a desired wort flow and an actual wort flow, the control valve (16) being opened further and the raking machine (5) being lowered further if the desired wort flow is less than the actual wort flow and vice-versa;

reducing the desired wort flow if a further increase in the actual wort flow is not to be caused by further opening of the control valve (16) or lowering of the raking machine (5);

**characterized in that**

the desired wort flow and the height of the raking machine (5) are additionally adjusted in dependence upon the turbidity of the outflowing wort so that an increase in turbidity will result in a less substantial lowering of the raking machine and a lower desired wort flow.

3. A method according to claim 2, **characterized in that** the change with time of the position of the control valve (16) is additionally taken into account as an input variable, and that fast opening of the control valve (16) leads to a decrease in the desired wort flow and to a lowering of the raking machine.

4. A method according to claim 2 or 3, **characterized in that** the inflow of sparge water will be increased above the actual wort flow, if the actual wort flow remains below the desired wort flow during a second wort, and that the inflow of sparge water will be reduced as soon as the actual wort flow approaches the desired wort flow.

5. A method according to one of the claims 2 to 4, **characterized in that**, in addition, a level in a lauter vessel (19) will be lowered, if the actual wort flow remains below the desired wort flow, especially if the end of the lautering of a first wort is at hand.
6. A method according to one of the claims 2 to 5, **characterized in that** the sparge water quantity will be reduced in the case of easy-running brews.
7. A method according to one of the claims 2 to 6, **characterized in that**, for triggering a deep cut, the position of the control valve (16), the actual wort flow (15), the height of the raking machine (5) and the turbidity are taken into account.
8. A method according to one of the claims 2 to 7, **characterized in that**, if the raking machine (5) has not been moved below a certain level during the first wort, the raking machine (5) will be moved at least once to a low position during a second wort.
9. A method according to one of the claims 2 to 8, **characterized in that** the lautered amount of first wort will be reduced, if a brew runs poorly during lautering of the first wort.
10. A method according to one of the claims 2 to 9, **characterized in that** the poorer the second wort runs, the later will the trub be added during a second wort.



## Abstract

A controller for controlling the flow of wort from a lauter tun, said controller being a fuzzy controller. A method of controlling the flow of wort from a lauter tun, said method comprising the following steps: controlling a control valve and a height of a raking machine in dependence upon a difference between a desired wort flow and an actual wort flow, the control valve being opened further and the raking machine being lowered further if the desired wort flow is less than the actual wort flow and vice-versa; reducing the desired wort flow if a further increase in the actual wort flow is not to be caused by further opening of the control valve or lowering of the raking machine; adjusting the desired wort flow and the height of the raking machine in dependence upon the turbidity of the outflowing wort so that an increase in turbidity will result in a less substantial lowering of the raking machine and a lower desired wort flow.

total wort: 350 hl  
first wort: 150 hl  
trub addition: 179 hl  
sparge water: 172 hl  
turbidity: 15 EBC

total wort: 350 hl  
first wort: 147 hl  
trub addition: 180 hl  
sparge water: 179 hl  
turbidity: 43 EBC

total wort: 350 hl  
first wort: 146 hl  
trub addition: 210 hl  
sparge water: 171 hl  
turbidity: 15 EBC

total wort: 350 hl  
first wort: 150 hl  
trub addition: 210 hl  
sparge water: 171 hl  
turbidity: 15 EBC

**Legend of Fig. 6:**

total wort: 350 hl  
 first wort: 150 hl  
 trub addition: 179 hl  
 sparge water: 180 hl  
 turbidity: 15 EBC

**Legend of Fig. 7:**

total wort: 250 hl  
 first wort: 143 hl  
 trub addition: 180 hl  
 sparge water: 180 hl  
 turbidity: 15 EBC

**Legend of Fig. 8:**

total wort: 350 hl  
 first wort: 149 hl  
 trub addition: 180 hl  
 sparge water: 179 hl  
 turbidity: 43 EBC

**Legend of Fig. 9:**

total wort: 350 hl  
 first wort: 150 hl  
 trub addition: 184 hl  
 sparge water: 180 hl  
 turbidity: 87 EBC

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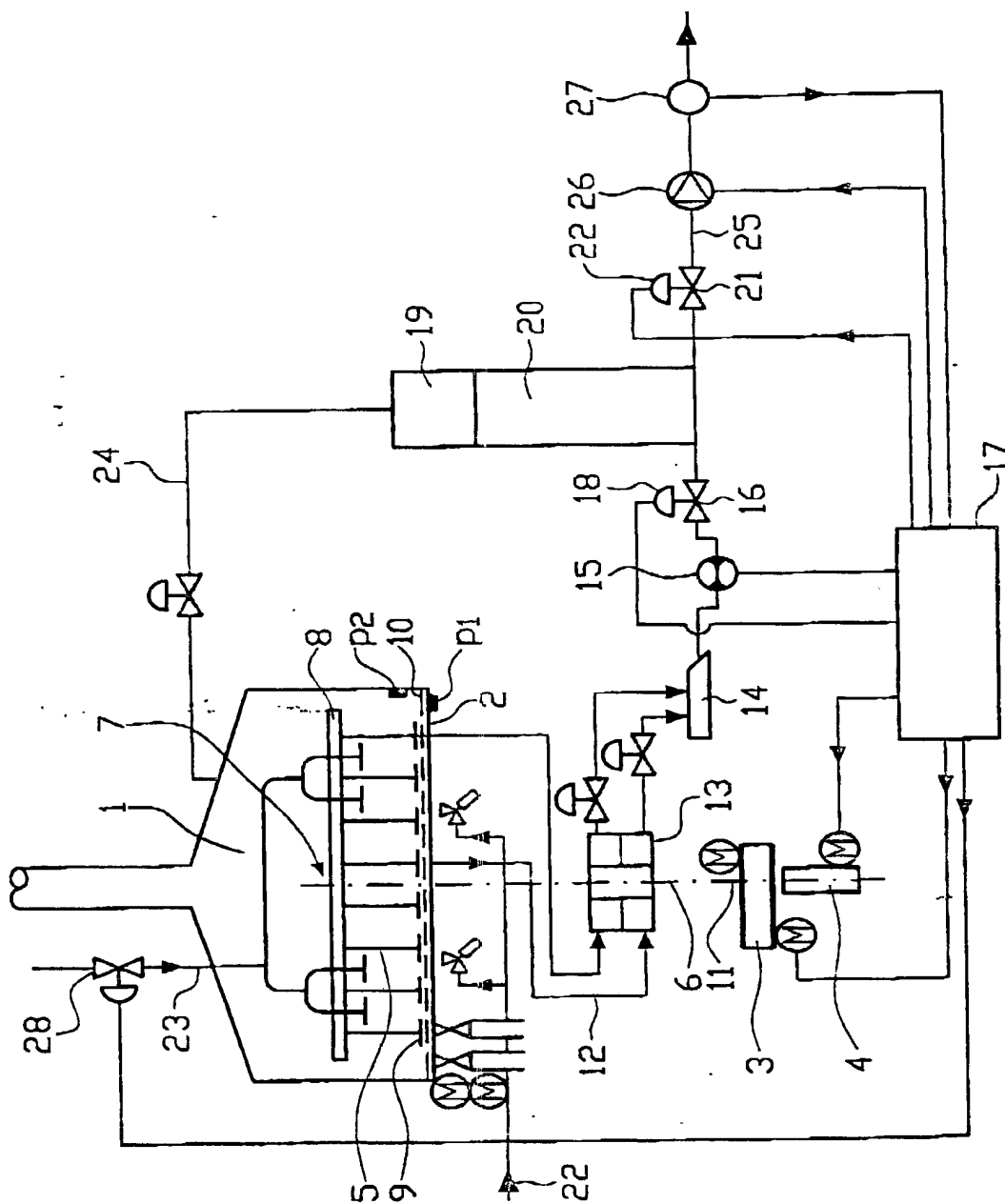


FIG. 1

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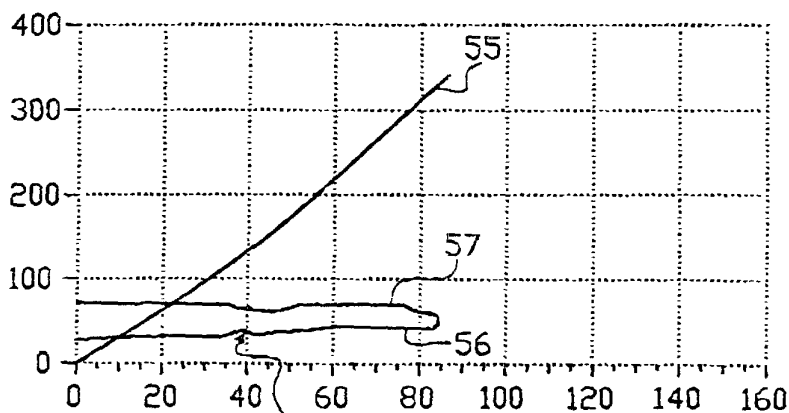
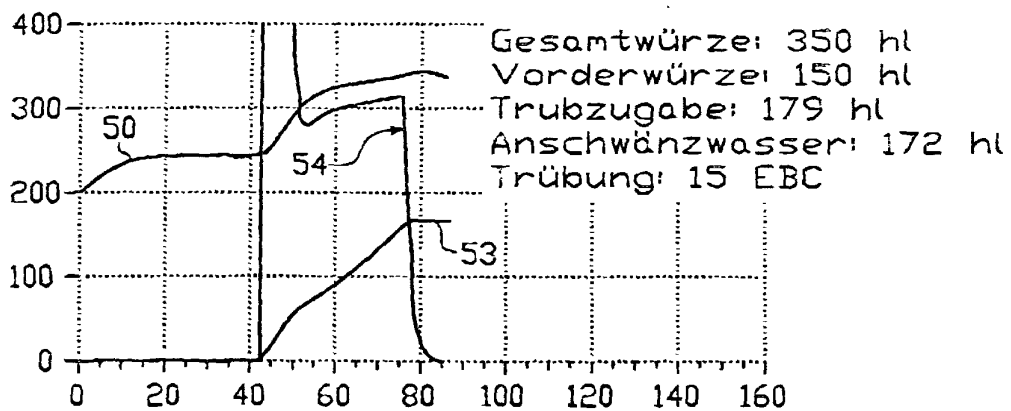
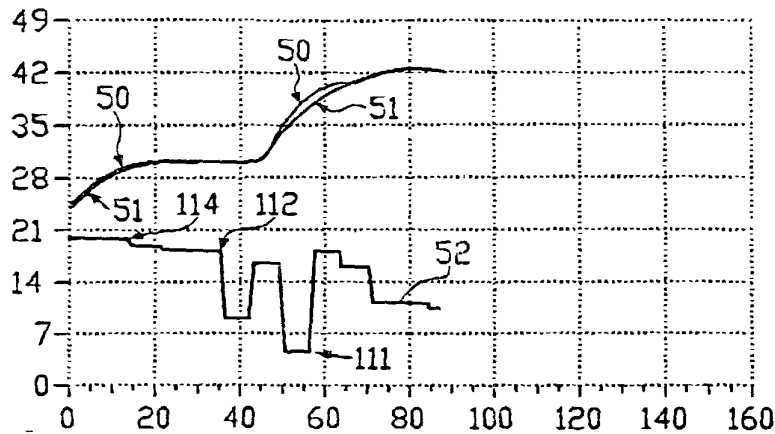


FIG. 2

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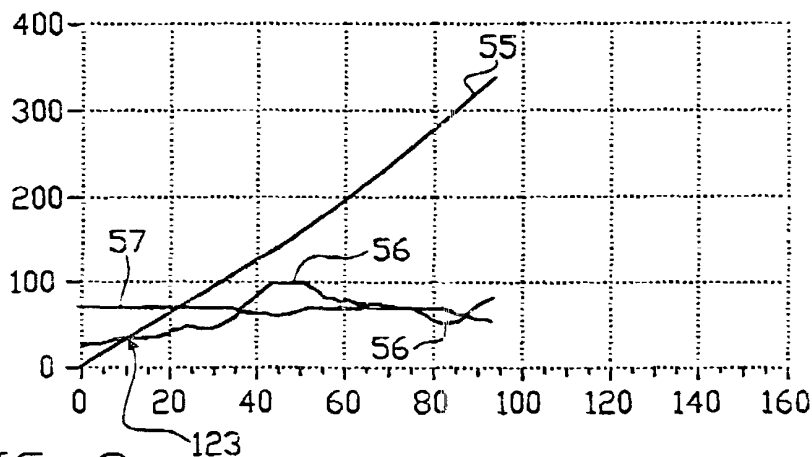
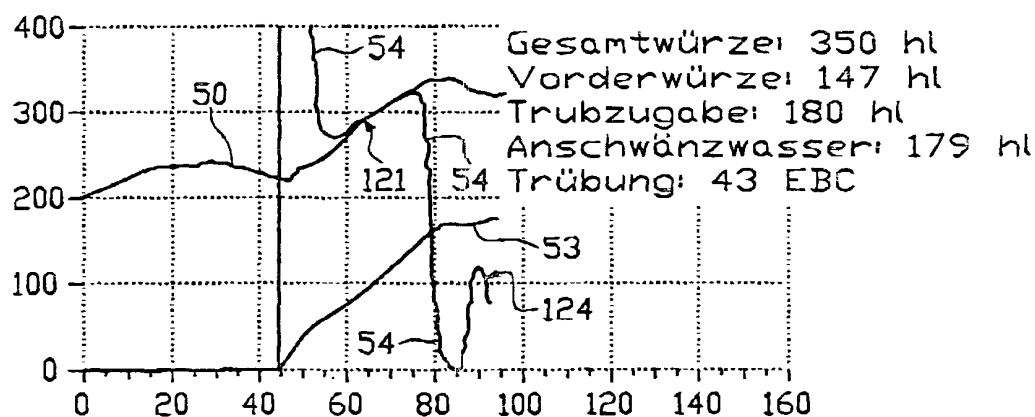
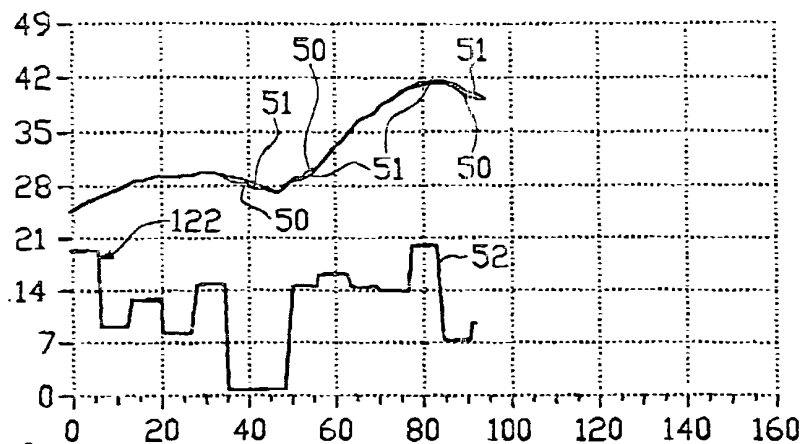


FIG. 3

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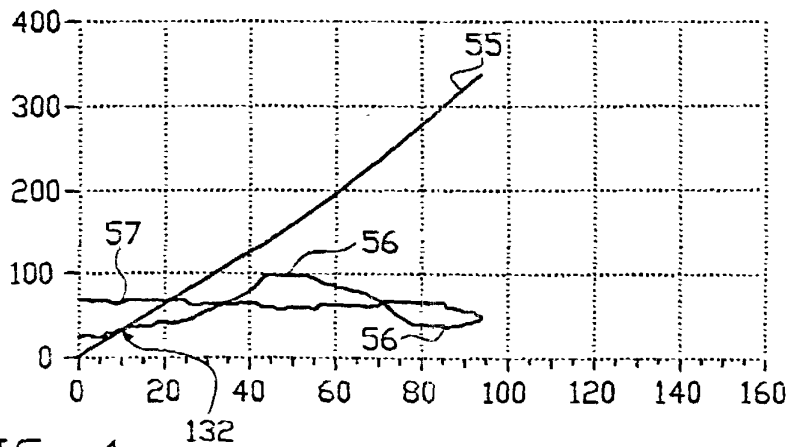
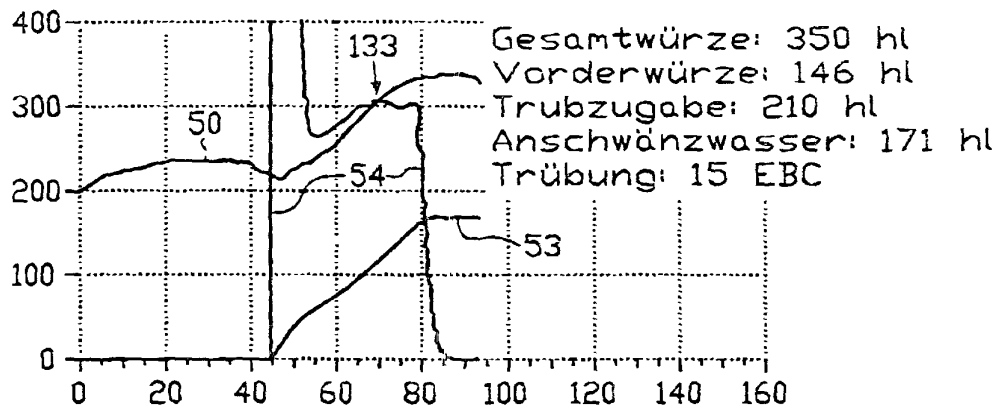
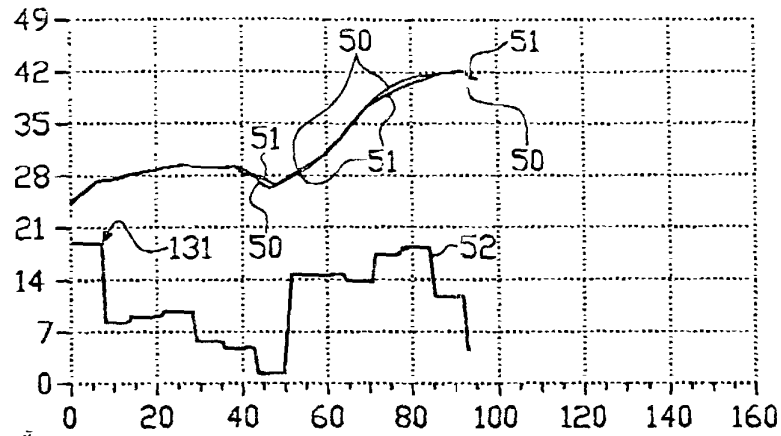


FIG. 4

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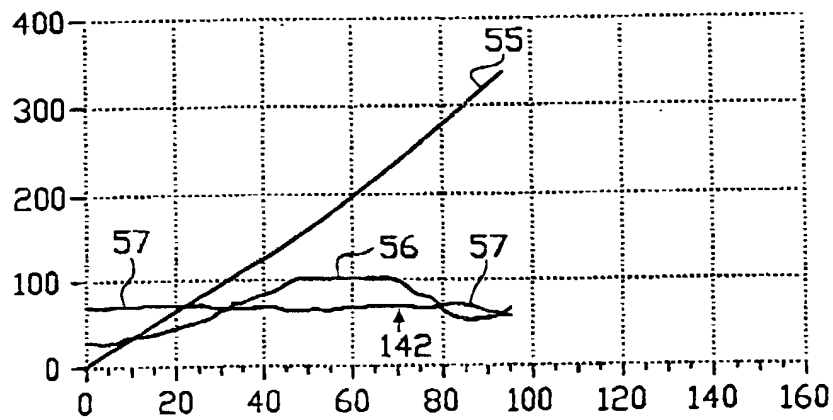
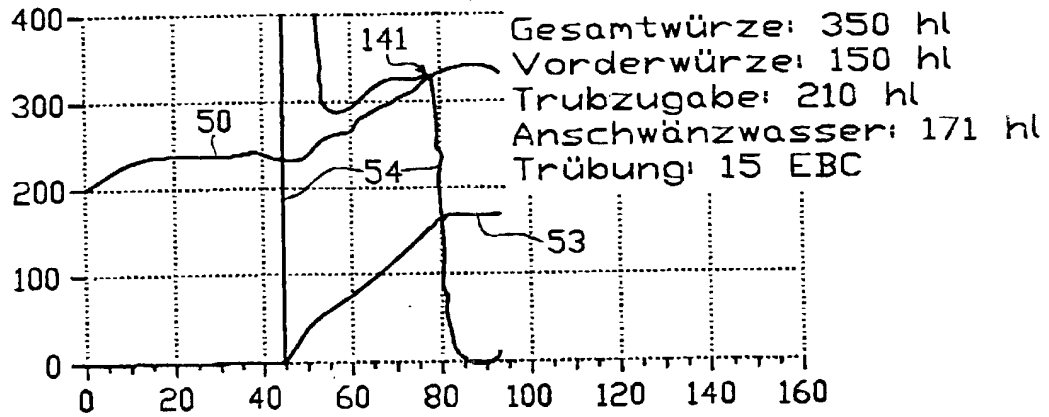
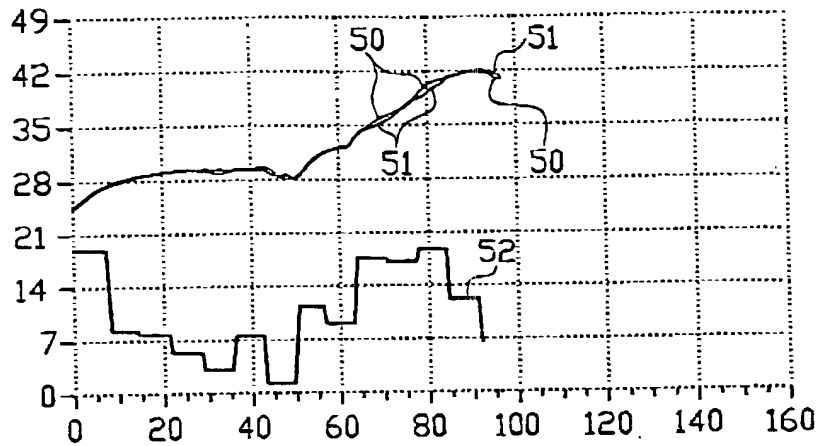


FIG. 5



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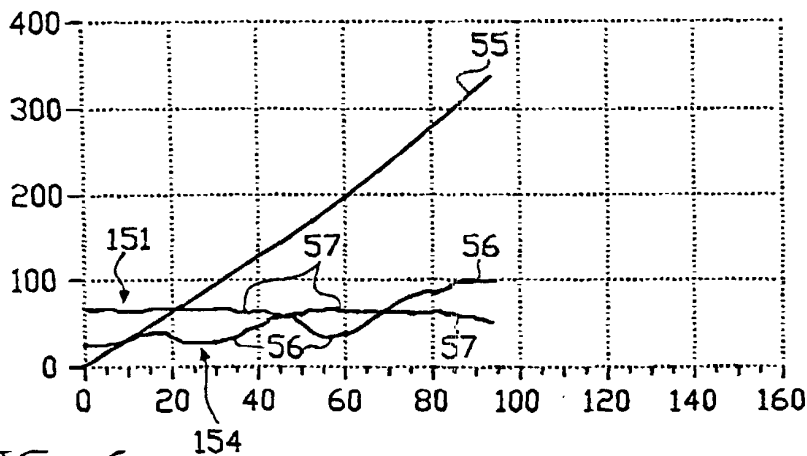
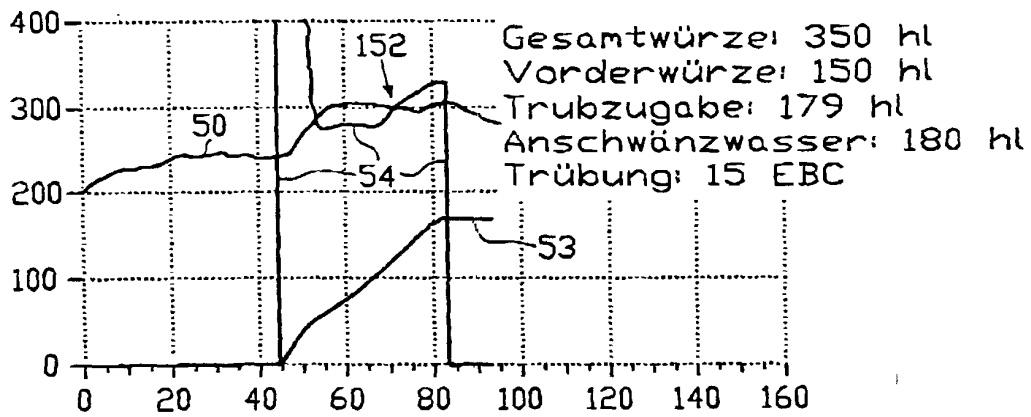
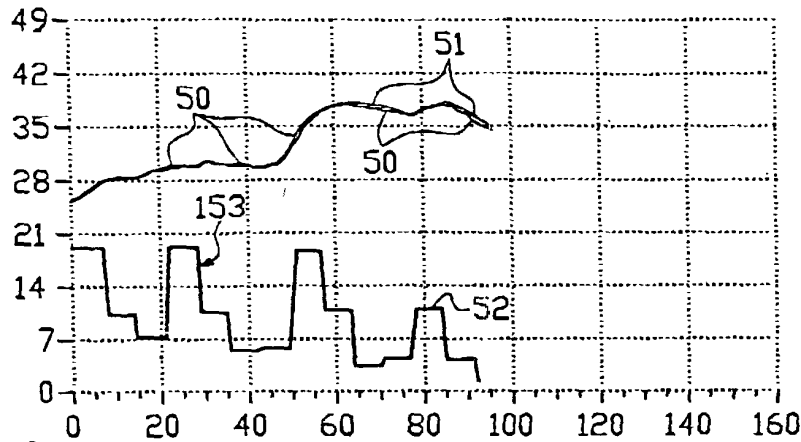


FIG. 6

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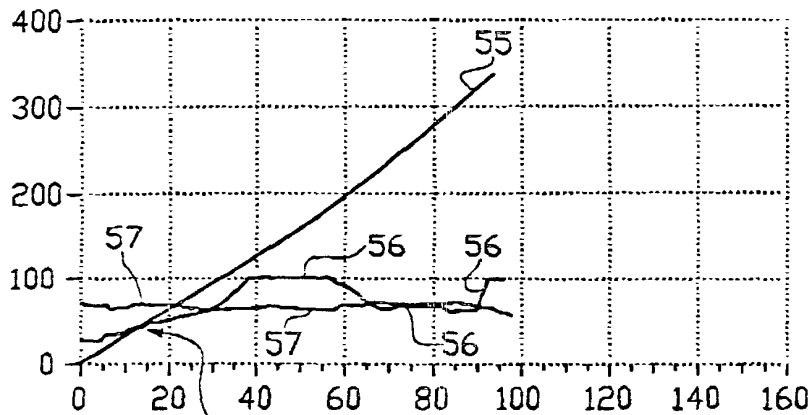
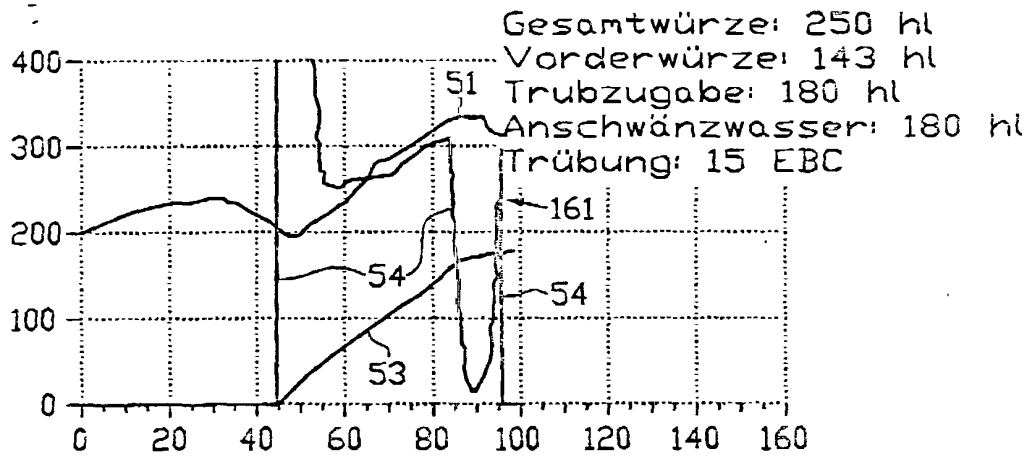
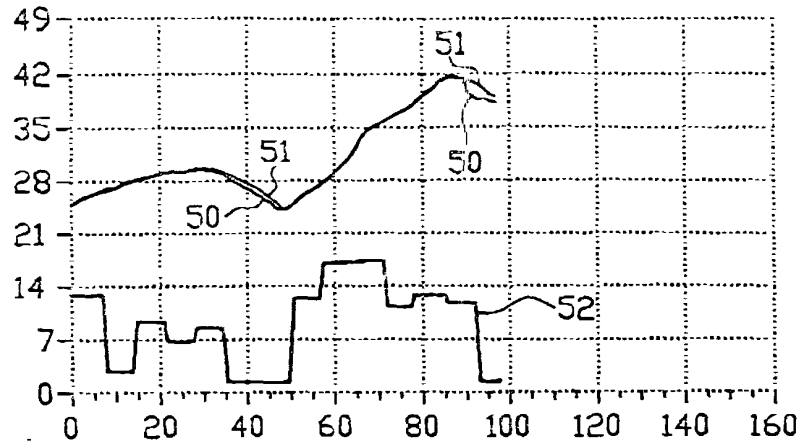


FIG. 7

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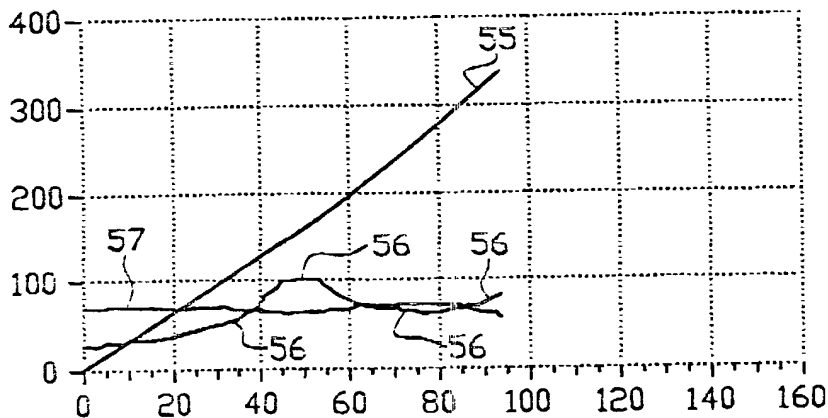
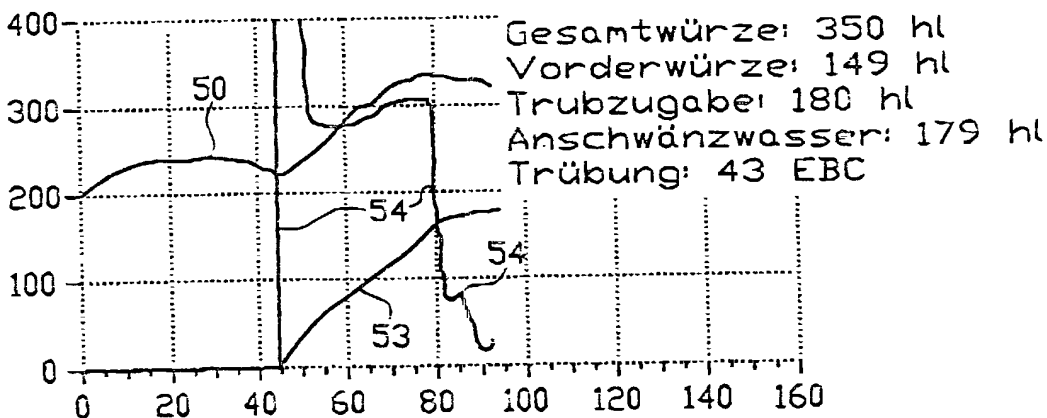
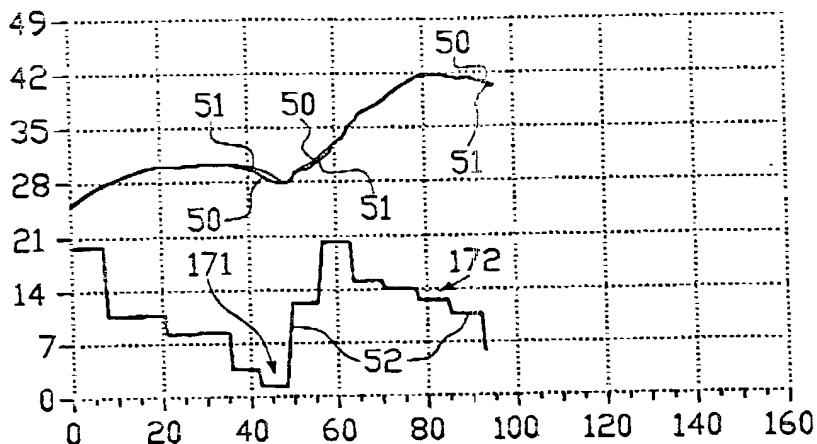


FIG. 8

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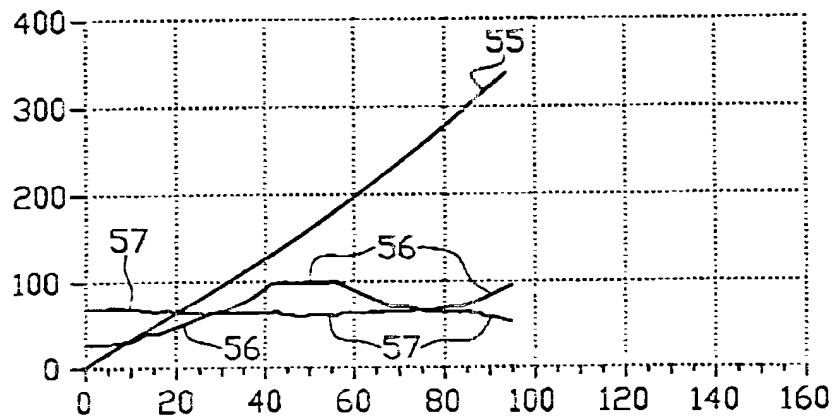
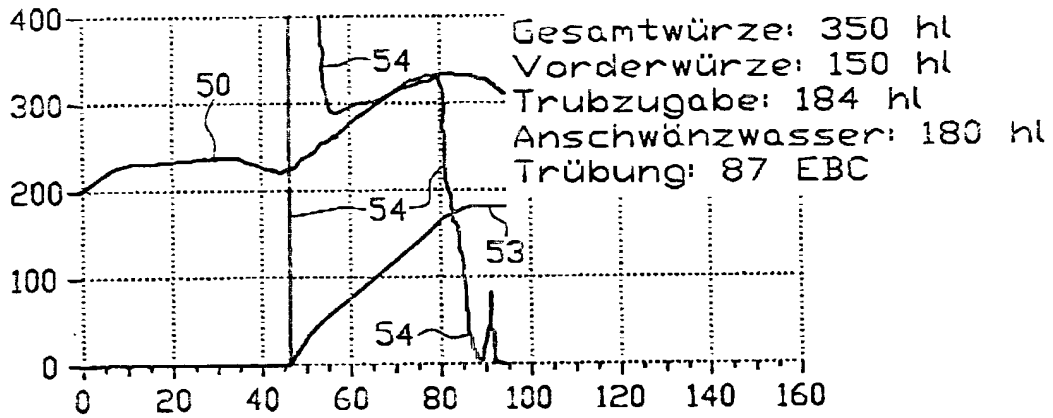
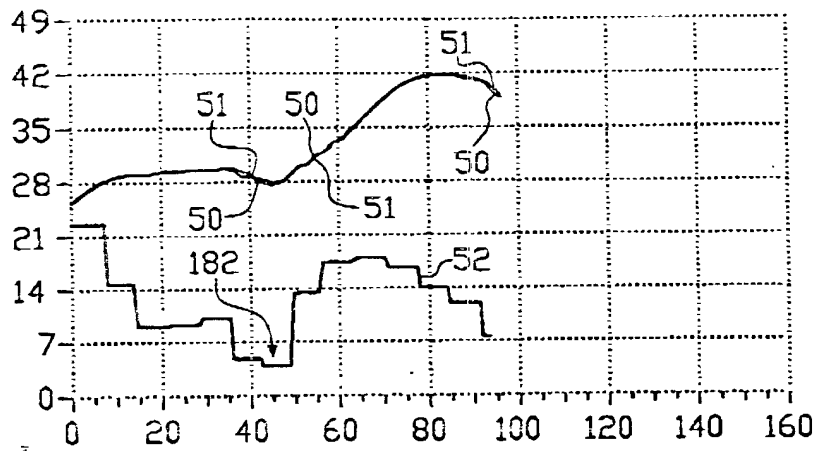


FIG. 9

# DECLARATION FOR PATENT APPLICATION AND POWER OF ATTORNEY

As a below named inventor, I hereby declare that my residence, post office address and citizenship are as stated below next to my name; I believe that I am the original, first and sole inventor (if only one name is listed below) or an original, first and joint inventor (if plural names are listed below) of the subject matter which is claimed and for which a patent is sought on the invention entitled "CONTROLLER AND METHOD FOR CONTROLLING THE FLOW OF BREWER'S WORT FROM A CLARIFYING VAT," the specification of which (check one): ☐ is attached hereto; ☒ was filed on December 7, 2001 as Application Serial No. 10/009,924 and was amended on \_\_\_\_\_ (if applicable); ☐ was filed as PCT International Application No. \_\_\_\_\_ on \_\_\_\_\_ and was amended under Article 19 on \_\_\_\_\_ (if applicable). I hereby state that I have reviewed and understand the contents of the above-identified specification, including the claims, as amended by any amendment(s) referred to above. I acknowledge the duty to disclose to the Patent and Trademark Office all information known to me to be material to patentability as defined in 37 C.F.R. §1.56.

I hereby claim foreign priority benefits under 35 U.S.C. §119 of any foreign application(s) for patent or inventor's certificate or of any PCT international application(s) designating at least one country other than the United States of America listed below and have also identified below any foreign application(s) for patent or inventor's certificate or any PCT international application(s) designating at least one country other than the United States of America filed by me on the same subject matter having a filing date before that of the application(s) of which priority is claimed:

<u>199 26 288.8</u>	<u>Germany</u>	<u>9 June 1999</u>	Priority Claimed
(Application Serial Number)	(Country)	(Day/Month/Year Filed)	<input checked="" type="checkbox"/> Yes <input type="checkbox"/> No
_____	_____	_____	<input type="checkbox"/> Yes <input type="checkbox"/> No
(Application Serial Number)	(Country)	(Day/Month/Year Filed)	

I hereby claim the benefit under 35 U.S.C. §119(e) of any United States provisional application(s) listed below:

_____	_____
(Application Serial Number)	(Day/Month/Year Filed)
_____	_____
(Application Serial Number)	(Day/Month/Year Filed)

I hereby claim the benefit under 35 U.S.C. §120 of any United States application(s) or PCT international application(s) designating the United States of America listed below and, insofar as the subject matter of each of the claims of this application is not disclosed in the prior application(s) in the manner provided by the first paragraph of 35 U.S.C. §112, I acknowledge the duty to disclose to the Office all information known to me to be material to patentability as defined in 37 C.F.R. §1.56 which occurred between the filing date of the prior application(s) and the national or PCT international filing date of this application:

_____	_____	_____
(Application Serial Number)	(Day/Month/Year Filed)	(Status-Patented, Pending or Abandoned)
<u>PCT/EP00/05362</u>	<u>9 June 2000</u>	<u>Pending</u>
(Application Serial Number)	(Day/Month/Year Filed)	(Status-Patented, Pending or Abandoned)

I hereby declare that all statements made herein of my own knowledge are true and that all statements made on information and belief are believed to be true; and further that these statements were made with the knowledge that willful false statements and the like so made are punishable by fine or imprisonment, or both, under 18 U.S.C. §1001 and that such willful false statements may jeopardize the validity of the application or any patent issued thereon.

## APPLICABLE RULES AND STATUTES

### 37 CFR 1.56. DUTY OF DISCLOSURE - INFORMATION MATERIAL TO PATENTABILITY (Applicable Portion)

(a) A patent by its very nature is affected with a public interest. The public interest is best served, and the most effective patent examination occurs when, at the time an application is being examined, the Office is aware of and evaluates the teachings of all information material to patentability. Each individual associated with the filing and prosecution of a patent application has a duty of candor and good faith in dealing with the Office, which includes a duty to disclose to the Office all information known to that individual to be material to patentability as defined in this section. The duty to disclose information exists with respect to each pending claim until the claim is canceled or withdrawn from consideration, or the application becomes abandoned. Information material to the patentability of a claim that is canceled or withdrawn from consideration need not be submitted if the information is not material to the patentability of any claim remaining under consideration in the application. There is no duty to submit information which is not material to the patentability of any existing claim. The duty to disclose all information known to be material to patentability is deemed to be satisfied if all information known to be material to patentability of any claim issued in a patent was cited by the Office or submitted to the Office in the manner prescribed by §§ 1.97(b)-(d) and 1.98. However, no patent will be granted on an application in connection with which fraud on the Office was practiced or attempted or the duty of disclosure was violated through bad faith or intentional misconduct. The Office encourages applicants to carefully examine:

- (1) prior art cited in search reports of a foreign patent office in a counterpart application, and
- (2) the closest information over which individuals associated with the filing or prosecution of a patent application believe any pending claim patentability defines, to make sure that any material information contained therein is disclosed to the Office.

Information relating to the following factual situations enumerated in 35 USC 102 and 103 may be considered material under 37 CFR 1.56(a).

### 35 U.S.C. 102. CONDITIONS FOR PATENTABILITY: NOVELTY AND LOSS OF RIGHT TO PATENT

A person shall be entitled to a patent unless --

- (a) the invention was known or used by others in this country, or patented or described in a printed publication in this or a foreign country, before the invention thereof by the applicant for patent, or
- (b) the invention was patented or described in a printed publication in this or a foreign country or in public use or on sale in this country, more than one year prior to the date of the application for patent in the United States, or
- (c) he has abandoned the invention, or
- (d) the invention was first patented or caused to be patented, or was the subject of an inventor's certificate, by the applicant or his legal representatives or assigns in a foreign country prior to the date of the application for patent in this country on an application for patent or inventor's certificate filed more than twelve months before the filing of the application in the United States, or
- (e) the invention was described in a patent granted on an application for patent by another filed in the United States before the invention thereof by the applicant for patent, or on an international application by another who has fulfilled the requirements of paragraph (1), (2), and (4) of section 371(c) of this title before the invention thereof by the applicant for patent, or
- (f) he did not himself invent the subject matter sought to be patented, or
- (g) before the applicant's invention thereof the invention was made in this country by another who had not abandoned, suppressed, or concealed it. In determining priority of invention there shall be considered not only the respective dates of conception and reduction to practice of the invention, but also the reasonable diligence of one who was first to conceive and last to reduce to practice, from a time prior to conception by the other.

### 35 U.S.C. 103. CONDITIONS FOR PATENTABILITY; NON-OBVIOUS SUBJECT MATTER (Applicable Portion)

A patent may not be obtained though the invention is not identically disclosed or described as set forth in section 102 of this title, if the differences between the subject matter sought to be patented and the prior art are such that the subject matter as a whole would have been obvious at the time the invention was made to a person having ordinary skill in the art to which said subject matter pertains. Patentability shall not be negated by the manner in which the invention was made.

Subject matter developed by another person, which qualifies as prior art only under subsection (f) or (g) of section 102 of this title, shall not preclude patentability under this section where the subject matter and the claimed invention were, at the time the invention was made, owned by the same person or subject to an obligation of assignment to the same person.

### 35 U.S.C. 112. SPECIFICATION (Applicable Portion)

The specification shall contain a written description of the invention, and of the manner and process of making and using it, in such full, clear, concise, and exact terms as to enable any person skilled in the art to which it pertains, or with which it is most nearly connected, to make and use the same, and shall set forth the best mode contemplated by the inventor of carrying out his invention.

POWER OF ATTORNEY: I hereby appoint as my attorneys, with full powers of substitution and revocation, to prosecute this application and transact all business in the Patent and Trademark Office connected therewith:

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Nate F. Scarpelli (22,320)  
Michael F. Borun (25,447)  
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Richard H. Anderson (26,526)

Patrick D. Ertel (26,877)  
Richard B. Hoffman (26,910)  
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State or Country GERMANY	State or Country
Date <input checked="" type="checkbox"/> 7.2.02	Signature <input checked="" type="checkbox"/> Ulrich Hege